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Bacteriological Surveillance and Assessment of Malete Well Water in Malete, Kwara State

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Abstract:

Majority of the population in Malete where research was carried out depend solely on wells as their major source of water supply because of the inexistence of treated pipeborne water. Due to increasing cases of water-borne diseases such as dysentery and cholera in some local Government areas in Kwara State recently, informed this bacteriological surveillance and monitoring of wells. Samples of well water were collected from seven different locations within Malete city in Nigeria and analyzed microbiologically using Membrane Filtration Technique and various isolated colony are tentatively identified based on their biochemical and physiological properties.The organisms were identified as *Salmonella sp, Pseudomonas sp, Shigella sp, Escherichia coli, Enterobacter aerogenes, Klebsiella sp, vibrio sp,serattia sp* and *Proteus sp.* The percentage occurrence of the organisms isolated from the well samples showed that *Staphylococcus aureus* was the most common (22.59%) followed by *Escherichia coli* (19.45%), and *Pseudomonas* species with 12.45% occurrence. Percentage occurrence of *Salmonella and Shigella* species were 8.95% and 12.45% respectively, while, *Serratia* species was the least with 2.72% occurrence. Conclusively, proper well location and construction of good wells should be encouraged; control of human activities to prevent sewage from entering water body is the key to the avoiding bacterial contamination of drinking water. Household treatment such as boiling, use of chlorine should be encouraged before water from these wells is used for drinking and all other domestic purposes.

Keywords:

Pathogens, Wells, Contamination, Surveillance, Water

1. Introduction

Surface water is the major source of drinking water in rural communities which is vulnerable to fecal contamination which is a major health problem [1]. In Rural area where there is no asses to pipe borne water feacal Contamination of drinking water is

of public health concerns due to the risk of water related diseases [2,3]. World health organization reported that the 80% of all diseases are associated with the inadequately treated and microbiologically poor water quality [1]. Most of the rural dwellers use untreated surface water obtained from rivers, dams and streams for drinking and other domestic purposes, as a result of the lack of access to portable water [4]. Drinking of contaminated water, inadequate sanitation, and poor hygiene have led to 1.8 million deaths per year as a result of infectious diarrhea [5].

The exposed water sources can be contaminated with sewage effluents, faeces from both human and wild life through rainfall run-off, which render them unfit for human consumption [6]. The unprotected water sources can be pruned contamination via sewage effluents, faeces from both human and wild life through rainfall run-off, which render them unsuitable for human consumption [6]. Drinking of the contaminated water is a global health threat, particularly in developing countries where an estimated 1.1 billion people do not have access to improved water supply for domestic, recreational purposes and sanitary waste disposal systems are major cause of illnesses in developing countries [7,3].

There too many cases of the reported and unreported outbreak of various water-related diseases in many state in Nigeria especially typhoid fever and Cholera; incidentally, World Health Organization recently reported cases of Cholera outbreak in some Local Government areas in Kwara State, as such this study becomes imperative to carry out water supply surveillance as a way of keeping a careful watch at all times from the public health point of view, over the safety and acceptability of drinking water supplies, through physical-chemical and bacteriological study of water in the area where inhabitants depend solely on surface water.

2. Materials and Methods

Isolation by Membrane Filtration Technique

Modified Method of Mulamattathil et al. [8] was used for the Isolation, Purification, and Characterization of selected emerging bacterial pathogens in well water samples. Water samples were obtained from various wells within Malete community. In order to sample large volume of the water samples, 100 mL of the water samples were passed through the membrane filter of 0.45 m pore size using membrane filter. The membranes were aseptically placed on the different agar media selective for various Disease transmitting pathogens such as Salmonella sp (SSA), Shigella sp (SSA) and Vibrio cholera ((TCBS).

Whiletotal coliforms and total thermotolerant coliforms were enumerated with the use of MarConkey agar and Eosin methylene blue (EMB) agar, incubated at 37 ℃ and 44.5 ℃ respectively depending on the availability of the media, nutrient agar was used for the heterotrophic bacteria counts. Each sample was analyzed in triplicate. The colonies were enumerated, characterized, and recorded. Their counts were expressed in cfu/100mL of the water.

3. Results

Total of seven well water samples were randomly selected across Malete community for bacteriological surveillance and analysis, three water samples were investigated from each well making a total of twenty one samples. Table 1 shows the total number of the bacteria from each well and specific pathogens. All the plates for

the Total Heterotrophic count were found to be numerous to count from all the sampling stations. W3 has highest number of total coliform of 134 cfu/100ml followed by W5 and W6 with 134cfu/100ml and 132 cfu/100ml respectively Mean values were significantly not different $p< 0.05$ (using Duncan Multiple Range Test, while the W2 has the least number of Total coliform counts. Incidentally, significant difference in the mean values of Total coliform counts in W4 and W7 does not exist at $p< 0.05$.

Similarly W7 has the highest mean values of Total thermotolerant counts, followed by W2 While Thermotolerant counts were not recorded in W3 and W5. The highest mean values of Vibrio counts were recorded in W7 followed by W4 and W1, while W5 has the least count of Vibrio counts. Duncan Multiple theorem shows that significant difference does not exist at $p = 0.05$ between W2, W3 and W6 similarly between W1 and W4 in their mean values of Vibrio count. The highest mean values of Salmonella counts was recorded in W4 followed by W7 and W3 with mean values of 74, 67 and 63 respectively with no significant differences ($P<0.05$). Highest number of Pseudomonas counts was recorded in W7 followed by W4 and W1; while it was not recorded in W3. Table 2 shows the results of the biochemical and physiological test carried out on the isolates and the isolates were tentatively identified. Table 3 shows the distribution of the isolates in all the sampled wells. *Salmonella sp, Vibrio sp, Pseudomonas sp and Enterobacter aerogenes* were found in all the wells while *E.*coli, Proteus sp, Serratia sp, Shigella sp and *Klebsiella sp* were evenly distributed.

The percentage distribution of the bacterial pathogens isolated from the well samples showed that *Staphylococcus aureus* was the most common (22.59%) followed by *Escherichia coli* (19.45%) and *Pseudomonas* species with 12.45% occurrence. Percentage occurrence of *Salmonella and Shigella* species were 8.95% and 12.45% respectively, while, *Serratia* species was the least with 2.72% occurrence shown in Table 4.

Table 1. *Total number of organism found in the well samples.*

WELL	THC	TCC	TTC	VC	SC	PC
W1	TNTC	110 ± 4.46^{b}	58 ± 3.25^{b}	23 ± 1.19^{ab}	50 ± 5.21^{b}	32 ± 4.70^{ab}
W2	TNTC	100 ± 7.11^{c}	72 ± 5.15^{a}	16 ± 0.75^{b}	38 ± 3.98^{c}	27 ± 5.55^{b}
W3	TNTC	134 ± 4.41^{a}	0.00 ± 0.00^{d}	20 ± 2.34^{b}	63 ± 7.16^{a}	0 ± 0.00^{c}
W4	TNTC	123 ± 6.51^{ab}	57 ± 2.16^{b}	26 ± 4.66^{ab}	74 ± 10.16^{a}	$36 \pm 4.11a^{b}$
W5	TNTC	132 ± 4.16^{a}	0.00 ± 0.00	12 ± 1.33^{c}	28 ± 2.45^{c}	25 ± 2.00^{b}
W6	TNTC	130 ± 3.33^{a}	40 ± 2.98^{c}	18 ± 2.51^{b}	15 ± 2.99^{d}	33 ± 2.65^{ab}
W7	TNTC	125 ± 3.12^{ab}	81 ± 7.61^{a}	32 ± 3.30^{a}	67 ± 5.50^{a}	41 ± 6.90^{a}

Mean values with different superscripts in the same column are significant different. Mean values were separated using Duncan Multiple Range Test (DMRT). Mean ± SEM

TNTC-Too Numerous to count;THC-total Heterotrophic count; TCC-Total Coliform Count; TTC-Total Thermotolerant Count;VC-Vibrio count; Salmonella Count; PC-Pseudomonas count.

Table 2. *Biochemical and Physiological Characterization of the Isolates.*

Colonies	Catalase	Oxidase	Citrate	Urease	Nitrate Reduction	Voges-proskaur	Methyl Red	LAC Ferm	Indole	Specific organism
Colony A	+	-	-	-	+	-	+	-	+	*Salmonella* sp
Colon	+	-	-	-	+	-	+	-	-	*Shigella* sp

y B										
Colony D	+	+	+	-	+	-	-	-	-	*Pseudomonas aureginosa*
Colony E	+	-	-	-	+	-	+	+	+	*Escherichia coli*
Colony F	+	-	+	+	+	+	-	+		*Klebsiella pneumoniae*
Colony G	+	-	+	+	+	+	-	+	-	*Enterobacter sp*
Colony H	+	-	+	-	+	+	-	-	-	*Serratia marcences*
Colony I	+	-	+	+	+	+	+	-	-	*Proteus mirabilis*
Colony J	+	-	+	+	+	+	+	+	+	*Staphylococcus aureus*

Table 3. *Distribution of bacterial isolates in well water samples.*

Isolates	Well 1	Well 2	Well 3	Well 4	Well 5	Well 6	Well 7
Salmonella sp	+	+	+	+	+	+	+
Shigella sp	+	-	+	+	+	-	+
Staphylococcus sp	+	+	+	+	+	+	+
Escherichia coli	+	-	-	+	-	+	+
Proteus mirabilis	-	-	-	+	-	+	+
Klebsiella pneumoniae	+	+	+	-	-	-	+
Enterobacter aerogenes	+	+	+	+	+	+	+
Pseudomonas auriginosa	+	+	+	+	+	+	+
Serratia sp	-	-	+	-	+	+	-
Vibrio cholerae	+	+	-	+	-	+	+

Table 4. *Occurrence of bacterial isolates in all the sampling wells in total heterotrophic count.*

Bacteria	Number of Isolates	Percentage (%)
Escherichia coli	50	19.45
Shigella sp	32	12.45
Salmonella sp	23	8.95
Pseudomonas sp.	37	14.40
Staphylococcus aureus	58	22.59
Enterobacter aerogenes	14	5.45
Proteus sp.	20	7.78
Proteus sp.	20	7.78
Serratia sp	7	2.72
Klebsiella sp	16	6.23
Total	257	

4. Discussion

Well water is a major source of water supply in Malete community where research was carried due to lack of access to the treated pipeborne water and as such consistent cases of water-borne diseases such as dysentery and cholera in some local

Government areas in Kwara State recently, informed this bacteriological surveillance and monitoring of wells. Several Authors have reported the contamination of well water in different rural communities across Nigeria [9,2,3] .The alarming high number of bacterial pathogens per 100 mL of the water samples such as Total and feacal coliforms, Salmonella and Shigella counts as well as the presence of Vibrio cholera can pose serious health harzard. Ngwa and Chrysanthus [10] also reported the occurrence of these pathogens have also been isolated from the water samples obtained from students residential areas.

Total heterotrophic counts is an indication of the contamination of easily decomposed organic natter while, faecal coliform contamination is largely from faecal sources [11]. Movement of Run-off water and dust particles during raining season into the unprotected wells may account for the high bacterial load recorded in this study [3].

The study affirmed the occurrence of total coliforms, faecal coliforms, heterotrophic bacteria and *Pseudomonas* in the water samples from the study area represent the incidence of water pollution and some of these isolated species are feacal indicators and potential pathogens [12]. This is similar to the work of Onyango*et al*. [13], Ngwa and Chrysanthus [10] and Gambo *et al*. [2] who reported high bacterial density and coliform counts in wells and borehole water. The high number of waterborne bacteria in the sampled water may be attributed to poor safeguarding of the wells as many of the wells are uncovered that may be contaminated with feacal materials through run water and percolation of sewage into the ground water sources [2]. Apparently, These organisms constitute potential pathogens that can pose severe health risks to consumers in general and immunocompromised individuals in particular [4], also therefore, the presence of these bacterial species in these well water samples rendered them unfit for drinking or human consumption [14]. High density of *Pseudomonas* spp. in the raw water may increase the chances of finding this species in treated water which is of public health concerns to individuals whose immune systems are compromised [15]. The Total heterotrophic count in the well water also confirmed that the well water is grossly contaminated. The heterotrophic bacteria counts are generally harmless; but some may harbour pathogenic features which may represent potential health risks to humans and animals. Thus, the high levels of heterotrophic bacteria from water sources, well water for drinking in Malete is of public health concern [8].

The well water in the present study were highly contaminated with one or more of the following isolates, *Staphylococcus aureus, Escherichia coli, Pseudomonas* species, *Proteus* species, *Salmonella* species, *Enterobacter* species, *Klebsiella* species, Vibrio sp and *Enterococcus* species, incidentally these organisms have been reported by many Authors as major contaminants in well water [9,10]. The incidence of these organisms from water consumed by humans is a serious health threat and possible signals future outbreak of water borne diseases [9].

5. Conclusions

Therefore, results of bacteriological evaluation of Malete Well water showed that the water is grossly contaminated. The behavioral and hygienic practices of the Malete community might be the major contributing factors to this high load of indicator organisms and specific pathogens especially Vibrio cholerae. Water quality

monitoring and surveillance studies of different water sources are consequently encouraged to prevent outbreak of waterborne diseases

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Author Contributions

Conceptualization: A.T.; N.O. Methodology: A.T., B.O.; N.O. Validation: A.T.; Formal analysis: N.O.; B.O; Investigation: A.T.; N.O.; B.O.; Resources: N.O.; Data Curation: A.T.; B.O.; N.O.; Writing – original draft preparation: N.O.; B.O.; Writing – review and editing: A.T.; Visualization: A.T.; B.O.; Supervision: A.T.; B.O.; Project administration: N.O.; Funding acquisition: N.O.

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References

[1] Negera, E.; Nuro, G.; Mulugeta Kebede, M. Microbiological assessment of drinking water with reference to diarrheagenic bacterial pathogens in Shashemane Rural District, Ethiopia. African Journal of Microbiology Research, 2017, 11(6), 254-263.

[2] Gambo, J.B.; James, Y.; Yakubu, M.B. Physicochemical and Bacteriological Analysis of Well Water at Crescent Road Poly Quarters, Kaduna. *International Journal of Engineering and Science*, 2015, 4(11), 11-17.

[3] Agwaranze, D.I.; Ogodo, A.C.; Nwaneri, C.B.; Agyo, P. Bacteriological Examination of Well Water in Wukari, Nigeria. *International Journal of Scientific Research in Environmental Sciences*, 2017, 5(2), 0042-0046.

[4] Biyela, P.T.; Lin, J.; Bezuidenhout, C.C. The role of aquatic ecosystems as reservoirs of antibiotic resistant bacteria and antibiotic resistance genes. *Water Science and Technology*, 2004, 50(1), 45-50.

[5] WHO (World Health Organization). Reducing risks, promoting Healthy life, Geneva, Switzerland, 2002. Available online: https://www.who.int/whr/2002/en/ (accessed on 30 May 2020).

[6] Obi, C.L.; Potgieter, N.; Bessong, P.O.; Matsaung, G. Assessment of the microbial quality of river water sources in rural Venda communities in South Africa. *Water SA*, 2002, 28(3), 287-292.

[7] WHO (World Health Organization). Using climate to predict infectious disease epidemics. World Health Organization, Geneva, 2005. Available online:

https://www.who.int/globalchange/publications/infectdiseases/en/ (accessed on 30 May 2020).

[8] Mulamattathil, S.G.; Bezuidenhout, C.; Mbewe, M.; Ateba, C.N. Isolation of Environmental Bacteria from Surface and Drinking Water in Mafikeng, South Africa, and Characterization Using Their Antibiotic Resistance Profiles. *Journal of Pathogens*, 2014, Article ID 371208, pp. 11.

[9] Idowu, A.O.; Oluremi, B.B.; Odubawo, K.M. Bacteriological analysis of well water samples in Sagamu. *African Journal of Clinical and Experimental Microbiology*, 2011, 12(2), 86-91.

[10] Ngwa, N.R.; Chrysanthus, N. Bacteriological Analysis of Well Water Sources in the Bambui Student Residential Area. *Journal of Water Resource and Protection*, 2013, 5, 1013-1017.

[11] Kolawole, O.M.; Ajayi, K.T.; Olayemi, A.B.; Okoh, A.I. Assessment of Water Quality in Asa River (Nigeria) and Its indigenous *Clarias gariepinus* Fish. *Int. J. Environ. Res. Public Health*, 2011, 8, 4332-4352.

[12] Webster, L.F.; Thompson, B.C.; Fulton, M.H.; Chestnut, D.E.; VanDolah, R.F.; Leight, A.K.; Scott, G.I. Identification of sources of *Escherichia coli* in South Carolina estuaries using antibiotic resistance analysis. *Journal of Experimental Marine Biology and Ecology*, 2004, 298(2), 179-195.

[13] Onyango, A.E.; Okoth, M.W.; Kunyanga, C.N.; Bernard Ochieng' Aliwa, B.O. Microbiological Quality and Contamination Level of Water Sources in Isiolo County in Kenya. *Journal of Environmental and Public Health*, 2018, Article ID 2139867, pp. 10.

[14] Okonko, I.O.; Adejoye, O.D.; Ogunnusi, T.A.; Fajobi, E.A.; Shittu, O.B. Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. *African Journal of Biotechnology*, 2008, 7(5), 617-621.

[15] Jeena, M.I.; Deepa, P.; Mujeeb Rahiman, K.M.; Shanthi, R.T.; Hatha, A.A.M.Risk assessment of heterotrophic bacteria from bottled drinking water sold in Indian markets. *International Journal of Hygiene and Environmental Health*, 2006, 209(2), 191-196.



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